Yale ENGINEERING

Sensing, Tracking, and Secured Communication with Artificial Electromagnetic Materials

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Metamaterials (MTMs) are synthetic electromagnetic materials possessing unique properties not found in natural materials. Their introduction has spurred the creation of innovative circuits with enhanced components. One notable metamaterial-based design is the composite right/left-handed transmission line (CRLH-TL) leaky-wave antennas (LWAs). These antennas offer continuous frequency-dependent beam scanning from backfire to endfire with a true broadside beam. They also ensure excellent impedance matching throughout their operational range, using a straightforward feeding mechanism. The CRLH LWAs' ability to map frequency to space means unknown target locations can simply be pinpointed by analyzing the spectral components of the returning wave. This paves the way for real-time detection, with data acquisition speeds mainly determined by the signal source's frequency sweep rate. The sensor's field-of-view is also expanded thanks to the wide scanning angle of CRLH LWAs. Such features enable applications like swift 2-D beamforming, expansive real-time remote sensing, vital sign monitoring, motion detection, and microwave imaging. Additionally, applying spatiotemporal modulation to CRLH LWAs can generate harmonic waves and enhance physical layer security, promoting safer wireless communication.

ECE

Hosted by
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ML 107 or Zoom